

descends from the neck to the ventral fins. The brown portion of the body coarsely reticulated with yellowish, the lines descending from the back to the belly. Caudal fin and a cuneiform band along the hinder half of the base of the dorsal yellow.

North-west coast of Australia (Duboulay).

IX.—On the Shell-structure of *Spirifer cuspidatus*, and of certain allied Spiriferidæ. By WILLIAM B. CARPENTER, M.D., F.R.S.

To the Editors of the *Annals of Natural History*.

GENTLEMEN,

Being now in a condition to give a complete and explicit reply to the question raised by Mr. Meek, on which I addressed you six months ago (*Ann. Nat. Hist.* Jan. 1867, p. 29), I take the earliest opportunity of communicating to you the results of my researches, which will be found, if I mistake not, of singular interest to such palæontologists as pay special attention to the *Brachiopoda*.

I think it due both to Mr. Meek and to myself to point out that the note in the 'Annals' for August, 1866 (p. 144), in which he is represented as calling in question the accuracy of my original observations on the imperforate structure of the shell of *Spirifer cuspidatus*, did not correctly express his views. In a letter with which he favoured me immediately on reading my previous communication he says:—

"I am sorry you had not seen my little paper before you read the notice of it to which you allude. If you had done so, I am sure you would have at once seen that I made no attempt whatever to cast doubts upon the accuracy of your investigations. I never for a moment questioned the fact that the shells examined by you are not punctate. The only question with me, after seeing, as I believed, very minute and very scattering punctures in the shells I had examined, was, whether there might not be in Ireland, and possibly in England, another rare type, not seen by you, indistinguishable by form and other external characters from *S. cuspidatus*, and yet widely separated by having a punctate structure. Believing that this might be the case, and knowing that, if so, it would be a matter of some interest to know which was the true *cuspidatus*, I published my remarks mainly in order to cause further investigations.

"As you have doubtless ere this seen my little paper, you must have observed that the words 'contrary to the opinion of Dr. Carpenter,' quoted by you, do not occur in it, nor any others

of the same meaning. Indeed the question never once suggested itself to my mind whether you might not have been mistaken in regard to the shells you had examined; for I assure you there is no one living in whose opinion on such a question I have more confidence than in yours"*.

The results I have now to communicate, whilst fully confirmatory of my original determination, also afford a complete verification of the sagacious guess thus put forward by Mr. Meek.

Through the kindness of Mr. Worthen and Mr. Meek, I have been furnished with the following materials for examination:—

1. Chips of the type species of the genus *Syringothyris*, established by Prof. Winchell on the basis of a very peculiar feature of internal structure, which differentiates it from ordinary *Spirifers*, viz. the connexion of the vertical dental plates (fig. 1 *l, l*) by a transverse lamina (fig. 2, *tr*) which gives off a pair

Fig. 1.

Fig. 2.

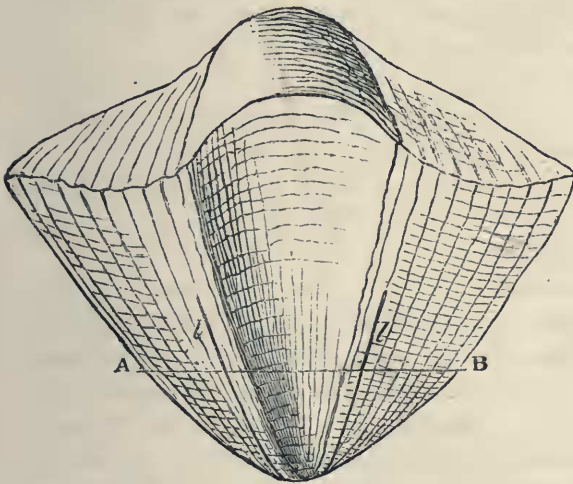


Fig. 1. *Syringothyris typha*, from a drawing by Prof. Winchell: *l, l*, dental plates; A B, plane of section.

Fig. 2. Section of *Syringothyris typha* across the plane A B, after Winchell: *l, l*, dental plates; *tr*, transverse lamina; *t*, incomplete tube.

of parallel lamellæ that curve towards each other so as nearly to meet on the median line, and thus form an incomplete tube (*t*)

* I cannot but contrast the courteous tone in which Mr. Meek (an entire stranger to me) has expressed his full reliance on my scientific accuracy in this matter with the treatment I continue to receive from Prof. King, who, in spite of my reiterated warnings against the fallacy of such superficial observations, has again (in the last number of the Geological Magazine) called in question the correctness of my statements, on no better evidence than that afforded by the examination of the *surface* of a specimen of *Spirifer cuspidatus* with a hand magnifier!

projecting into the interior of the shell. This peculiarity not being indicated by any corresponding peculiarity of external conformation, shells which are now found to present it have been ranked among Spirifers by our very highest authorities*.

2. Chips of the shells which have been ranked by American palæontologists as *Spirifer cuspidatus* and *Sp. subcuspidatus*.

3. Chips of the shell referred to by Mr. Meek as having been sent to Mr. Worthen by Mr. Davidson as a typical specimen of *Spirifer cuspidatus* from Millecent in Ireland.

In all the foregoing specimens the shell-structure was extremely well preserved.

Through the kindness of Mr. Jukes, who sent a collector to Millecent on purpose to obtain for me specimens of the last-mentioned type, I have also been enabled to examine—

4. Two entire specimens of reputed *Spirifer cuspidatus* from Millecent. Although there was but little shell on these specimens, that little was well preserved, and proved quite sufficient for my requirements.

Finally, the readiness of Mr. Davidson to make any needful sacrifice for the sake of arriving at the whole truth on this point has led him to place at my disposal—

5. The entire specimen of *Spirifer cuspidatus* from Millecent, figured by him in his 'Carboniferous Brachiopoda' (plate 8. fig. 19) as a typical representative of the species. The shell of this specimen is so well preserved that lamellæ scaled off from it could scarcely be distinguished from those of a recent *Rhynchonella*.

All the foregoing specimens have been examined under magnifying-powers of from 50 to 100 diameters, (1) by mounting in Canada balsam such lamellæ as were already thin enough to be transparent, and (2) by grinding down such chips as were originally opaque until they became thin enough to be seen through, and then mounting them in Canada balsam. This is the method which I have uniformly practised, when able to do so, in the examination of the shells of fossil Brachiopoda; and I consider it the only one by which satisfactory results can be obtained. A natural lamella gives the structure of that particular layer of which it formed part, whilst a thin section procured by grinding will generally traverse all the layers of the shell. The following are the facts thus revealed as to the structure of the specimens just enumerated:—

1. The type-specimen of Prof. Winchell's *Syringothyris* exhibits distinct perforations of about 1-3000th of an inch in diameter, set at an average distance of about 1-300th of an

* A fully illustrated description of this genus, by Mr. Davidson, will be found in the ensuing (July) Number of the Geological Magazine.

inch from each other. They are not distributed, however, with the uniformity which usually prevails in the shells of the perforated Brachiopoda; for patches of imperforate shell intervene between portions that are pretty regularly perforated, and sometimes a fragment large enough to fill a great part of the field of view is entirely imperforate. This, I feel certain, is not the result of any alteration produced by fossilization, the shell-structure being equally well preserved in the perforated and in the imperforate parts. Prof. Winchell speaks of this shell as "impunctate in all conditions and under high powers,"—a statement for which I can only account on the supposition that he happened to examine only minute fragments which chanced to be imperforate, as occurred to myself in my first examination of No. 4.

2. The *Spirifer cuspidatus* and *Sp. subcuspidatus* of the United States palæontologists are unquestionably perforated; and precisely resemble the preceding not only in the size of the perforations and in their distance from each other, but also in the *patchiness* of their distribution.

3. The Millecent (Irish) shell in Mr. Worthen's possession exhibits exactly the same combination of imperforate with perforated structure; and I have no doubt that it was the uncertainty produced by this peculiarity which led Mr. Meek, in transmitting me chips for examination, to express a doubt whether he had been originally correct in asserting the presence of perforations in this shell.

4. The two Millecent specimens obtained for me by Mr. Jukes also unquestionably exhibit the same character of *patchy* perforation; but I might not have ascertained the existence of perforations if I had not carefully scrutinized every lamella of shell that I could scale off, all the fragments first examined having chanced to be imperforate.

5. Mr. Davidson's typical specimen of *Spirifer cuspidatus*, also from Millecent, exhibits *not the smallest trace of perforations*, though I have scaled off from it flakes of such size, and from so many different parts (including also both its outer and its inner layers), that I feel justified in confidently asserting that this shell is essentially *imperforate*.

Thus, then, whilst my previous determination of the *imperforate* structure of *Spirifer cuspidatus* is fully borne out by the examination of a remarkably well-preserved specimen of that type (No. 5), this result is in apparent contradiction to the fact that shells (Nos. 2, 3, 4) not externally distinguishable from it are indubitably *perforated*. The difficulty has been entirely removed, however, by an examination of the internal structure of these shells, the results of which are in complete harmony with

the singular correspondence between the *patchy* distribution of the perforations in Nos. 2, 3, 4 and that which is characteristic of *Syringothyris* (No. 1)—a correspondence which is the more significant as I have not elsewhere encountered this peculiarity.

On slicing across my *perforated* Millecent specimens (No. 4) in the direction indicated by Prof. Winchell's figure, the internal structure of one of them proved to be sufficiently well preserved to show most distinctly the transverse lamina (fig. 3, *tr.*) con-

Fig. 3.

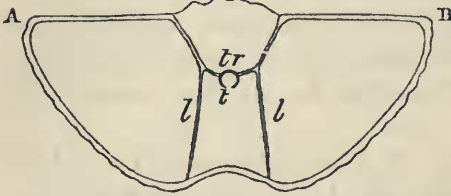


Fig. 4.

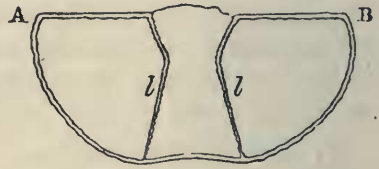


Fig. 3. Transverse section of *Syringothyris* from Millecent, from a drawing by Mr. Davidson: *l, l*, dental plates; *tr*, transverse lamina; *t*, incomplete tube.

Fig. 4. Transverse section of true *Spirifer cuspidatus* from Millecent, from a drawing by Mr. Davidson: *l, l*, dental plates.

necting the dental plates (*l, l*), with its projecting pair of lamellæ forming the nearly complete tube (*t*) characteristic of the typical *Syringothyris* (figs. 1, 2), to which genus, therefore, these shells are obviously to be transferred.

Nothing, then, remained save to subject the *imperforate* shell of the true *Spirifer cuspidatus* (No. 5) to the same crucial test; and on carrying a section through this specimen in precisely the same direction (A B), it proved that its dental laminae (*l, l*, fig. 4) are unconnected by any transverse plate, and that there is no vestige whatever of the characteristic tube of *Syringothyris*.

Thus, then, the remarkable fact is incontestably established that there is an exact *isomorph* of *Spirifer cuspidatus*, not distinguishable from it by external conformation, but generically differentiated by a very marked peculiarity of internal structure, of which peculiarity the perforated structure of the shell seems (so to speak) to be the exponent.

It would be difficult, I think, to find a more significant proof of the value of the microscopic test than this result has afforded; and I venture to hope that, as I have spared neither time nor trouble in the investigation, and am prepared to stake my scientific character upon the accuracy of the observations now detailed, they may not be lightly called in question.

I should add, in conclusion, that, in addition to the foregoing, I have examined chips of the shells of the following species of

reputed Spirifers sent to me from America by Mr. Meek :—*Sp. Hannibalensis* (Swallow), *Sp. capax* (Hall), *Sp. ? hemiplicatus* (the type of a new genus *Syntrilasma*), all of which are unquestionably perforated. On the other hand, a chip sent to me by Mr. Meek of a little shell which he states to be the type of Prof. Hall's genus *Ambocoilia* (= *Orthis umbonata*, Con.) is as certainly imperforate. But, after the experience above described, I should hesitate to pronounce on the absence of perforations in a shell allied to this group, except after the examination of several such fragments.

I remain, Gentlemen,

Your obedient Servant,

WILLIAM B. CARPENTER.

University of London, June 17, 1867.

P.S. I have to add that, having learned from Mr. Davidson that the typical structure of *Syringothyris* is exhibited by a Belgian shell hitherto known as *Spirifer distans*, I have reexamined the only example of this type at present accessible to me, the one contained in the Museum of the Royal School of Mines. So far as I can judge from the minute fragments of shell, not very well preserved, which this specimen has afforded, I should still say that it is imperforate. But the experience I have now acquired from the Millecent shells leads me strongly to desire a more complete investigation of this type; and I should be greatly obliged to any of your readers who may be able to supply me with well-preserved specimens of it. It does not seem improbable that the reputed *Spirifer distans* of Belgium, which proves to be truly a *Syringothyris* (see Davidson, *loc. cit.*), may be, like the Millecent shell, an isomorph of a true *Spirifer*.

BIBLIOGRAPHICAL NOTICE.

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3. *The Bath Flora. A Lecture delivered to the Members of the Bath Natural-History and Antiquarian Field Club.* By the Rev. L. JENYNS. Bath, 1867.
4. *Flora of Norfolk: a Catalogue of Plants found in the County of Norfolk.* By the Rev. K. TRIMMER. London, 1866.

THESE four tracts on the flora of Britain have recently reached us. They differ considerably in intention and character, but are well deserving of notice. The first has the peculiarity of being a partial flora of a district in England, printed and published at Calcutta.